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THE ACADIAN TRIASSIC

SIDNEY POWERS
Troy, New York

CONTENTS

PART I

INTRODUCTION
    General Relations
    General Geography and Geology of the Region
        Topography
        Geology

THE NEWARK GROUP IN THE ACADIAN AREA

DESCRIPTIVE GEOLOGY
    Stratigraphy
        Grand Manan
        Split Rock
        Quaco
        Martin Head
        Waterside
        Advocate Harbour
        Cape Sharp
        Partridge Island
        Greenhill–Five Islands
        Five Islands

PART II

Gerrish Mountain
Gerrish Mountain–Truro
Truro–Wolfville
Wolfville–Scots Bay
Scots Bay–Bennetts Bay
Digby Gut
Rossway–Brier Island
Age

PART III

STRUCTURE
Folds
Faults
Theories of Origin
IGNEOUS ROCKS
Distribution
Five Islands Volcanics
North Mountain Basalt
ORIGIN

PART I

INTRODUCTION

GENERAL RELATIONS

The Acadian Triassic is preserved as a rather narrow, discontinuous border to the Bay of Fundy and Minas Basin. The Bay of Fundy has a northeast-southwest trend, with the island of Grand Manan at the entrance. The Triassic extends from the southwest end of Grand Manan to Truro, a distance of 195 miles. The width of the Bay of Fundy, from Digby to St. John, is 45 miles. On both the New Brunswick and the Nova Scotia shore, the Triassic appears: in New Brunswick on Grand Manan Island, at Split Rock (Gardner's Creek), Quaco, Martin Head, and Waterside; in Nova Scotia on the island of Isle Haute, and in a quite continuous strip from Advocate around Minas Basin and down the Bay of Fundy to Brier Island at the entrance.

The field work in connection with this paper occupied a portion of the summers of 1913 and 1914. In the field work, the writer is indebted for suggestions to Professor J. W. Goldthwait, Dr.

A. O. Hayes, and Mr. W. A. Bell of the Geological Survey of Canada, and to Professor D. S. McIntosh of Halifax, Nova Scotia. Professor Alfred C. Lane of Tufts College has kindly permitted the use of thin sections and drill cores of the Cape D'Or basalt. To Professor R. A. Daly, under whose direction this paper was prepared as a portion of a thesis for the degree of Doctor of Philosophy in Harvard University, special thanks are due for helpful criticism.

GENERAL GEOGRAPHY AND GEOLOGY OF THE REGION

Topography.—The most important topographic feature of the Bay of Fundy region is North Mountain, extending from Cape Blomidon to Brier Island, 125 miles. South of North Mountain is the Annapolis Valley and the land of Evangeline, a broad fertile plain extending from Minas Basin to the Annapolis Basin. South of the Annapolis Valley is South Mountain, whose crest stands on a level with North Mountain, at an elevation of about 400 feet.

On the northern side of the Bay is the island of Grand Manan, presenting an abrupt escarpment on the west, rising 200 to 400 feet out of the sea. The tops of these basaltic cliffs is again at the level of North Mountain. On the east side of Grand Manan is a rolling lowland fronted by many islands. The New Brunswick shore is bounded by rocky cliffs rising to a height of 50 to 200 feet, but between the Triassic exposures at Quaco and Waterside, the cliffs rise to the summit level of 400 feet.

Minas Basin is surrounded by lowlands, presenting a rather flat surface at elevations of 100 to 150 feet, except for the tidal marshes. On the north, the Cobequid Mountains rise to heights of 500 to 800 feet, with "peaks" at 1,000 feet.

Geology.—The controlling factor of the topography and geology of the region is the direction of the orographic axes, from northeast to southwest (Fig. 1). The Bay of Fundy is confined between a broad belt of pre-Cambrian rocks in Nova Scotia, fronted by the Triassic; and a less broad belt of pre-Cambrian rocks in New Brunswick, fronted by Carboniferous and Triassic strata (Fig. 2). The peninsula of Nova Scotia is composed largely of pre-Cambrian strata intruded by Devonian granite.

Minas Basin is bounded by Triassic rocks, below and around which are Carboniferous and Permian strata. To the north, separated by a normal fault, are the Cobequid Mountains, which are composed of Silurian schists and quartzites with various associated igneous rocks. North and west of the Cobequids are Carboniferous and Permian strata, stretching northward over the Magdalen Islands and over Prince Edward Island.

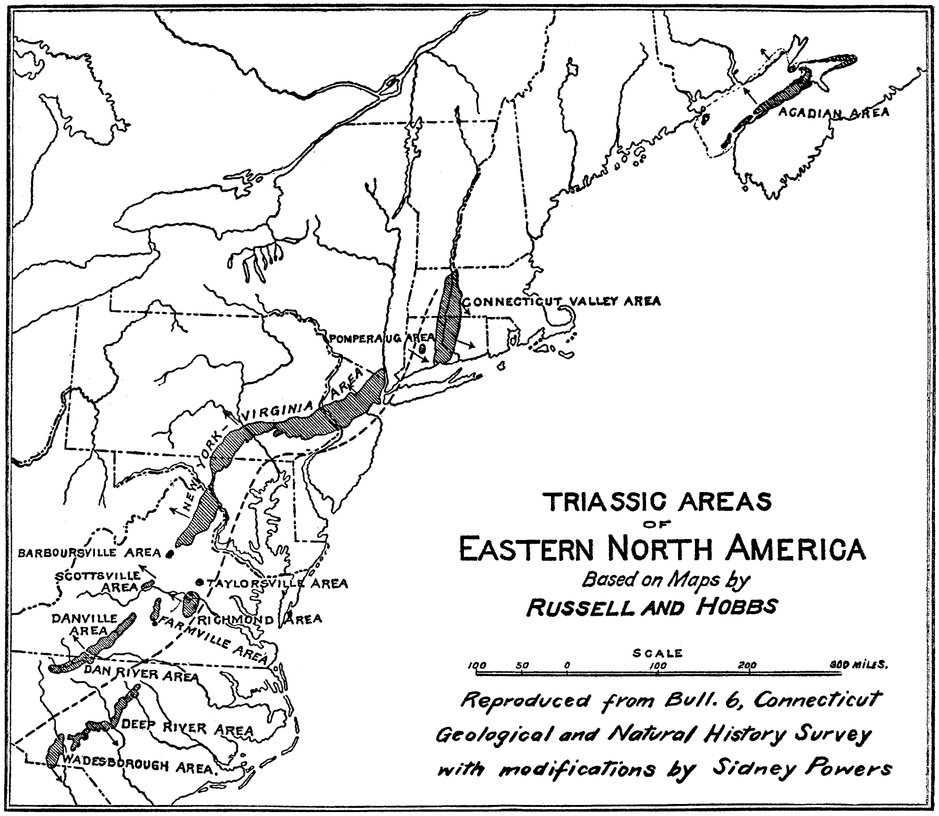

FIG. 1.—The Newark group in North America

THE NEWARK GROUP IN THE ACADIAN AREA

The first reference to the Triassic in the Maritime Provinces is by Alger, in 1827.[1] Six years later, a description of the Triassic rocks was published by Jackson and Alger.[1] At about that time Gesner began his work in connection with the Geological Survey of New Brunswick and mentions the Triassic in each of his reports.[2]

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[1] F. Alger, "Notes on the Mineralogy of Nova Scotia," *Am. Jour. Sci.*, XII (1827), 227–32.

From 1835 to the present, a number of writers have discussed the Acadian Triassic in part or in whole, and, as Russell has given a bibliography of these papers in his correlation paper on "The Newark System,"[3] only the more important and the recent papers need be noted here.

Dana gave the name "Acadian Area" to this mass of Triassic rocks in his *Manual of Geology* (2d ed., 1875). Three years later, Dawson issued the second edition of his *Acadian Geology*, in which volume is the only account of the Triassic in Nova Scotia and New Brunswick. From 1863 to 1880, G. F. Matthew and L. W. Bailey were employed by the Geological Survey of Canada in mapping southern New Brunswick. In their reports are descriptions of the outliers of Triassic strata in New Brunswick.

The more recent work on the Acadian Triassic is that published by L. W. Bailey on the Digby Neck region[4] and by H. Fletcher

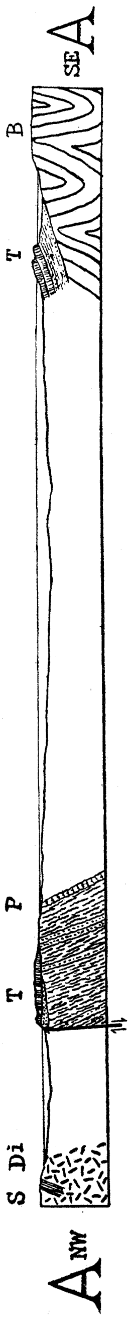

FIG. 2.—Geologic cross-section, AA, of the entrance to the Bay of Fundy, through Quoddy Head, Maine, on the northwest, the island of Grand Manan near by, and Long Island on the southeast. *P*, pre-Cambrian; *B*, Meguma series (pre-Cambrian); *S*, Silurian; *Di*, Diabase (Devonian?); *T*, Triassic. The Triassic shales under the basalt on Grand Manan appear only on the north. The Triassic sediments south of Long Island are submerged. Note the longitudinal valley on Long Island between the flows.

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[1] C. T. Jackson and F. Alger, "Remarks on the Mineralogy and Geology of Nova Scotia," *Am. Acad., Mem.*, N.S., I, 217–330.

[2] The reports are given in the bibliography of all literature on the Newark System, in I. C. Russell's correlation paper on "The Newark System," *U.S. Geol. Surv., Bull. 85*, 1892.

[3] *Ibid.*

[4] L. W. Bailey, "Report on the Geology of Southwestern Nova Scotia," *Geol. Surv. Canada, Ann. Rept.*, IX (1898), Part M.

who mapped the Minas Basin region[1] for the Geological Survey of Canada.

The former extent of the Acadian area is indeterminate, but it is probable that it extended several miles in all directions beyond the present boundaries. The original form appears to have been a basin with its northern limit near the Cobequid Mountains and its southern limit not far south of Grand Manan and Brier Island. There may have been a ridge of older rock extending out into the basin where the eastern side of Grand Manan now is, provided that the interpretation of the geology of that island, as given below, is correct.

The Newark group in the Acadian area has been divided into the following formation:

		Thickness in Feet
Top, an erosion surface		
Scots Bay formation (calcareous white sandstone)		25–(2,000 ?)
North Mountain basalt (a succession of lava flows)		800– 1,000
Annapolis formation (red beds, largely calcareous)	Blomidan shale	500– 1,000
	Wolfville sandstone	2,000– 2,500
		3,325– 6,500
Base, an unconformity with Paleozoic or older rocks		

Interbedded in the Annapolis formation, near its top, are certain basalt flows: agglomerate and tuff beds near the Five Islands, grouped under the name Five Islands volcanics. At Quaco, New Brunswick, there is a conglomerate horizon in the center of the red sandstones correlated with the Annapolis formation, and this conglomerate is called the Quaco conglomerate.

DESCRIPTIVE GEOLOGY

The descriptive geology of the Acadian Triassic will be taken up by localities, giving a brief description of the lithological and structural details. A number of detailed maps and sections are introduced, which may be connected with the region as a whole, by reference to the general map (Fig. 3), and the columnar sections

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[1] H. Fletcher, various papers which have been printed in the annual and summary reports of the Geological Survey of Canada from 1887 to 1907. See especially the *Annual Report*, V (1892), Part P.

(Fig. 4). The principal structural features and the details concerning the igneous rocks are summarized in a separate section.

STRATIGRAPHY

Grand Manan.—The island of Grand Manan is situated 4 miles southwest of Quoddy Head, the most easterly point in the United States. It is 15 miles long and 6 miles wide in the widest part. To the east and south are numerous islands and reefs.

Grand Manan was first visited by a geologist—Abraham Gesner—in 1838, then by Bailey,[1] Verrill,[2] and Ells.[3] Bailey visited most of the adjoining islands and gives the best description of the geology.

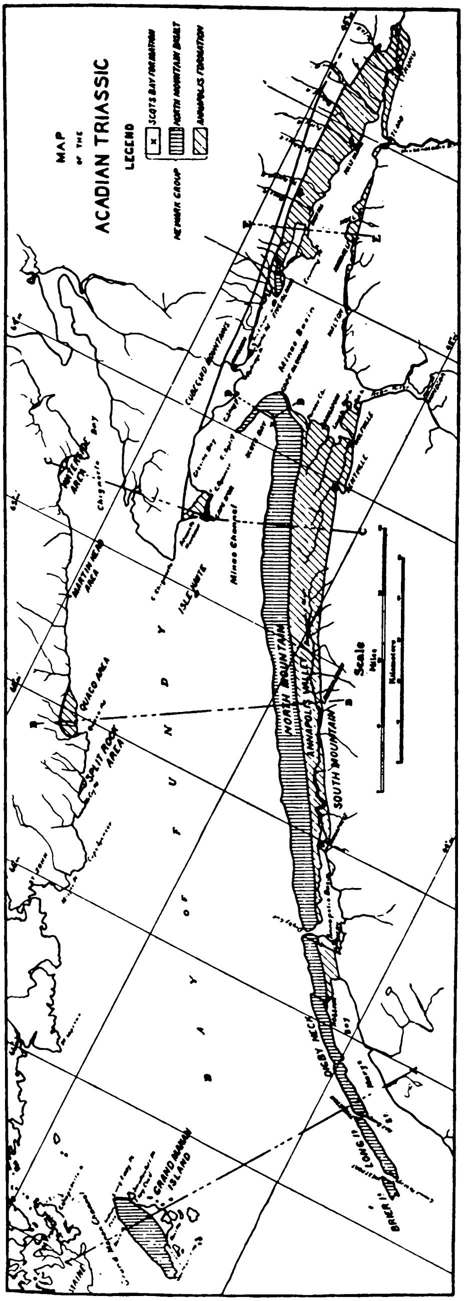

FIG. 3.—Map of the Acadian Triassic

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[1] L. W. Bailey, "The Physiography and Geology of the Island of Grand Manan," *Can. Nat.*, VI (1872), 43 ff.; also see Bailey, Matthew, and Ells, "Preliminary Report on the Geology of Southern New Brunswick," *Geol. Surv. Canada, Rept. Progress* (1870), pp. 216–21.

[2] A. E. Verrill, Appendix E to Dawson's *Acadian Geology*, 3d ed. (1878), pp. 679–80.

[3] R. W. Ells, *Geol. Surv. Canada, Summary Rept.*, VIII (1894), 271*A*.

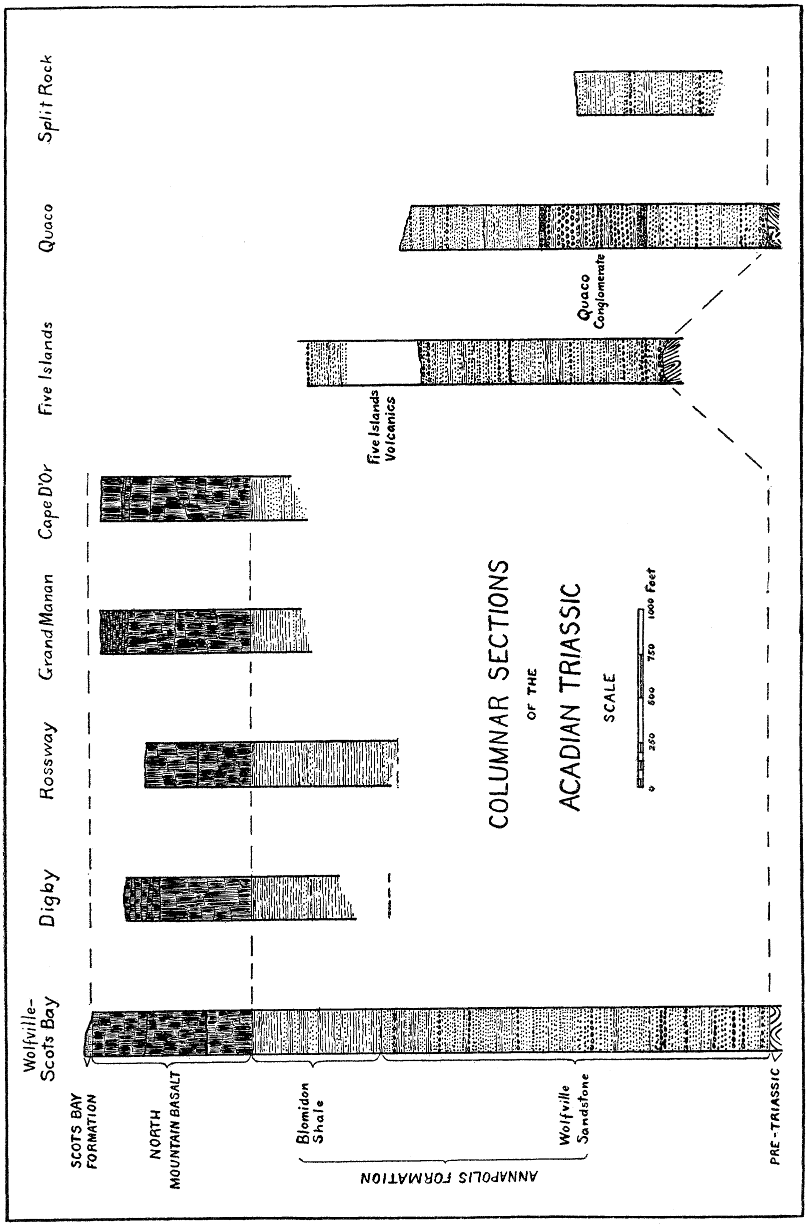

FIG. 4.—Columnar sections of the Acadian Triassic

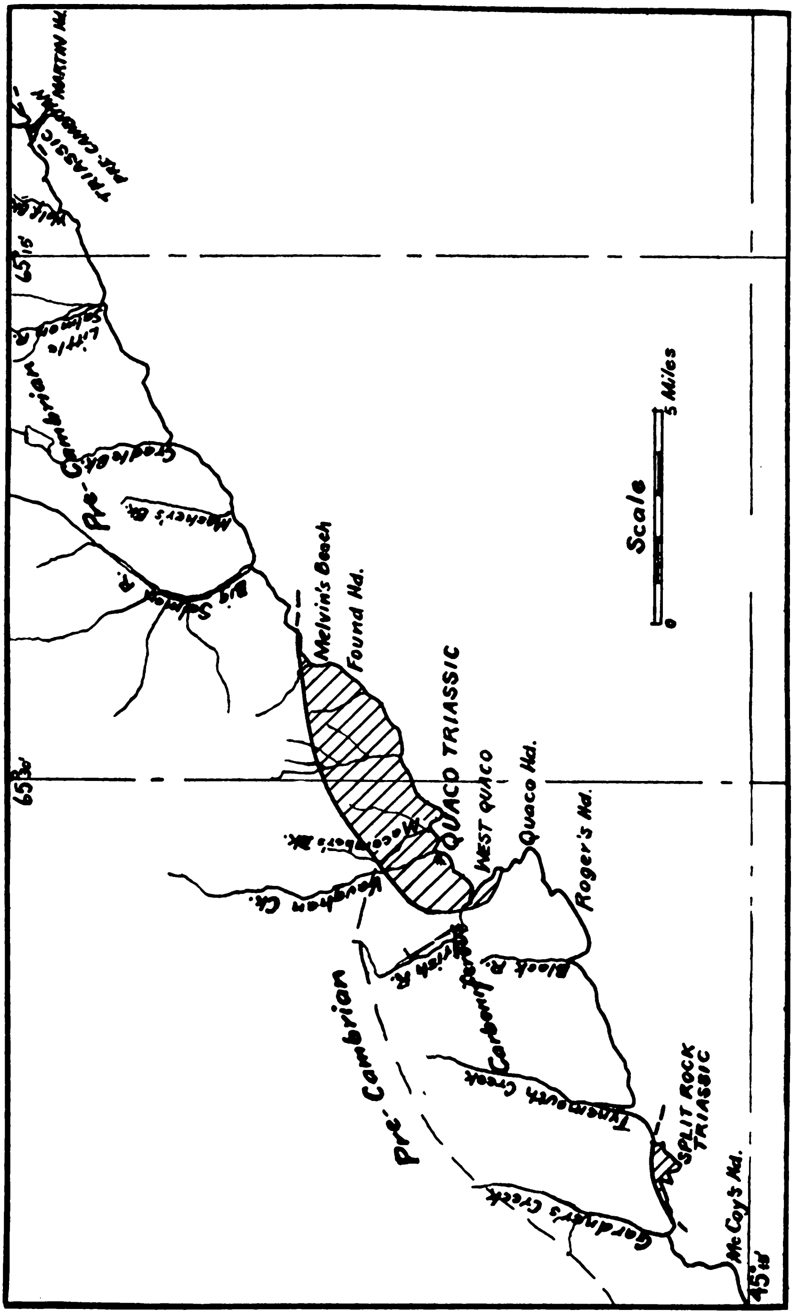

FIG. 5.—Map of the Split Rock, Quaco, and Martin Head, Triassic areas

The physiography and geology of Grand Manan divide the island into two provinces: a western upland underlain by Triassic basalt flows, and an eastern lowland underlain by pre-Silurian[1] metamorphic rocks. The upland represents the level of the Summit[2] peneplain, at elevations of 200–400 feet. The western coast of the island is fronted by cliffs rising abruptly in an almost straight line to a height of 100–300 feet.

The Triassic rocks of the island consist of basalt flows underlain by purple shale. The shale is exposed to a thickness of only 50 feet, and this exposure is at Dark Harbour, on the western side of the island. The basalts rest directly on older, metamorphic rocks on the eastern side of the island; at Red Head, on the south, and at the northwestern end of Flag Cove, on the north. At the former locality the contact dips 35 degrees, suggesting a fault, but the recent weathering of the rocks near the contact obscures the exposure.

The basalt flows are thick at the base and thin at the top. The exact thicknesses are given below with the résumé of the igneous rocks. The dip of the flows is variable. At Dark Harbour it is practically horizontal, but north of this place, the dip is down toward the north at angles of 5 to 15 degrees. It is difficult to determine the horizontal extent of any one flow. Diabase dikes are reported by Bailey at several places, one of which is Swallow-Tail Light.

The faults on Grand Manan are obscured by the massive character of the basalt. The major fault bounds the west side of the island, and the cliffs, which run in an almost straight line for 15 miles, mark the fault-line scarp. East-west faults are less prominent. One may occur at Dark Harbour, as many of the streams flowing across the Newark basalts follow fault-lines. Minor faults are seen in the shore exposures.

Split Rock.—Eighteen miles east of St. John, between Gardner's Creek and Tynemouth Creek, there is a strip of Triassic sediments about two miles long, and three-quarters of a mile wide at Split Rock itself (Figs. 5 and 6). This point should not be confused with one southwest of St. John by the same name.

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[1] The age of these rocks is probably pre-Cambrian, as they are older than the Silurian rocks of the Eastport Quadrangle. See E. S. Bastin, *U.S. Geol. Survey, Geol. Atlas*, Eastport Folio (No. 192) (1914), p. 14.

[2] The term "Summit" peneplain is used instead of "Cretaceous" peneplain in order to avoid any reference to the age of this topographic feature.

This area is bounded on the north by a fault which has brought the Triassic into contact with the Carboniferous. The dip of the Triassic red sandstones, shales, and occasional conglomerates is in general northward at angles of about 45 degrees, but the beds flatten out at split rock itself. The sediments show occasional cross-bedding. The conglomerates contain only occasional pebbles, and these pebbles are subangular, with occasionally very angular, and rarely rounded surfaces. They do not show striations or sand-blasted surfaces. Fragments of silicified wood have been found near Gardner's Creek, and are noted by Dawson in his *Acadian Geology*.

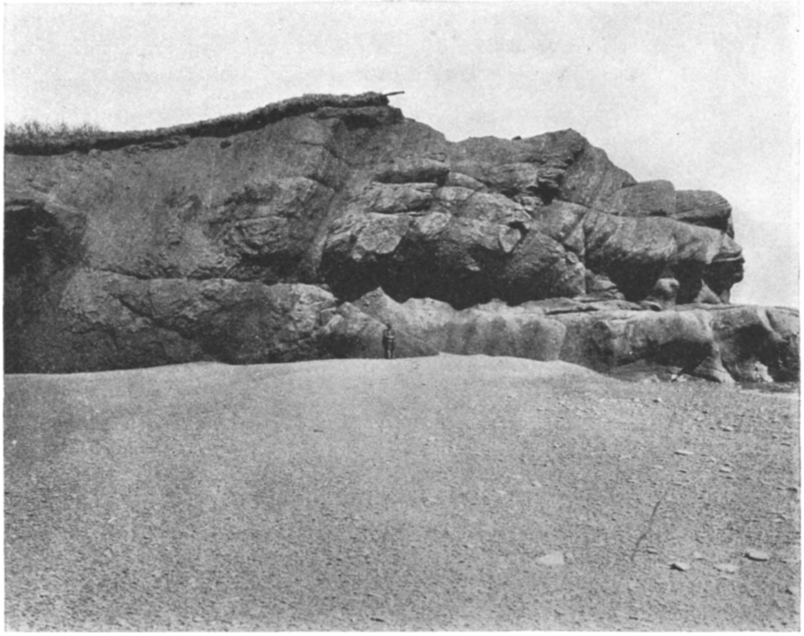

FIG. 6.—The Triassic shales near Gardner's Creek (Split Rock), dipping northward. The marine shelf has been cut at high tide level.

Quaco.—A large area of Triassic sediments occurs at Quaco, now known as St. Martin. The Triassic extends from West Quaco to Melvin's Beach, and includes the large area mapped as Lower Carboniferous on the map of the Geological Survey of Canada, issued in 1880. The length of the area is 7½ miles and the width 3 miles, as shown in Fig. 5. The shore exposures furnish an excellent structural cross-section of the area.

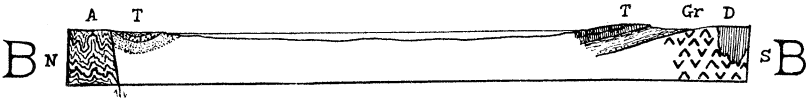

FIG. 7.—Geologic cross-section, BB, from Quaco, on the north, through North Mountain, the Annapolis Valley, and South Mountain, on the south. *A*, pre-Cambrian; *D*, Devonian; *Gr*, Devonian granite; *T*, Triassic.

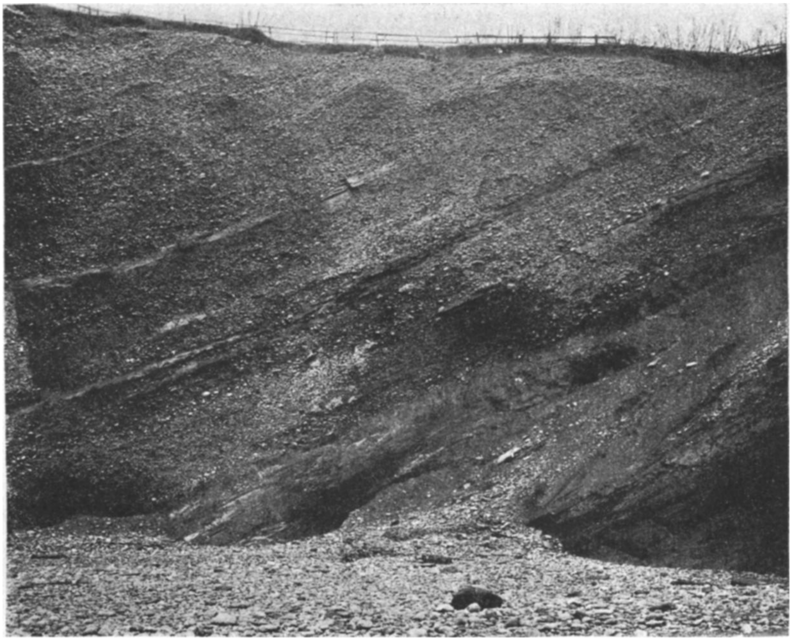

FIG. 8.—The contact of the lower red sandstone and the Quaco conglomerate above, near Macomber Brook, Quaco. The contact is a conformity. There is a very sharp boundary both in lithology and in color which is obscured by a pile of talus in the center of the picture.

The structure of the Quaco area is synclinal, with an east-west axis (Figs. 7 and 8). The contact of the Newark rocks with older rocks is shown at West Quaco, where there is an unconformity of red Triassic sandstone on greatly pointed, pre-Triassic traps. The basal sandstone contains occasional pebbles of various kinds of rock but contains no residual soil of the trap. At the unconformity there is minor cross-faulting in a northeasterly direction. At Melvin's Beach, on the northeast, the Triassic sandstones are seen, with steeply dragged dips, in fault-contact with pre-Cambrian metamorphics.

The stratigraphy of the area shows two normal red sandstone members, separated by a conglomerate of pale yellow color. Interbedded in the conglomerate are persistent beds of sandstone, a few inches in thickness, at stratigraphic distances of 10–30 feet, as shown in Fig. 8. The conglomerate is composed of rather loosely consolidated subangular to rounded stream gravels. Many of the pebbles show impressions of one pebble into another, and other recemented fractures.[1] In no other locality of the Acadian Triassic is such a conglomerate found.

The section was estimated as follows:

Upper red sandstone	800–1,000+
Quaco conglomerate	450– 700
Lower red sandstone	300– 300
	1,550–2,000

UNCONFORMITY WITH CARBONIFEROUS

Plant remains occur at several horizons in the Quaco series. Silicified wood was found by the writer within 50 feet of the top of the lower red sandstone, at Vaughan Creek, and by members of the Geological Survey of Canada at other localities. These fossils are correlated with the fragments of lignite from Split Rock and Martin Head. On account of the exposure of the basal unconformity of the Newark at West Quaco, it is probable that the Quaco exposure is to be correlated with the Annapolis formation, and that it is below the horizon of the North Mountain basalt, as shown in Fig. 4.

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[1] These conglomerates are similar to those of Upper Devonian age on the north side of Scaumenac Bay, Province of Quebec, described by J. M. Clarke, *Bull. Geol. Soc. Am.*, XXVI (1915).

Martin Head.—Martin Head is 20 miles northeast of Quaco. The Head itself is composed of a mass of pre-Cambrian strata, 100 feet in height, connected to a point of land by a shingle beach (Fig. 9). On the northern side of the Head is some red clay, apparently of Pleistocene age, which may be underlain by Triassic sediments.

North of the barrier beach are low cliffs of Triassic strata, exposed only on the west side of the peninsula. The bedrock is exposed for half a mile in the form of a syncline, with the longer limb on the south. On the north, the Triassic is faulted against the pre-Cambrian, as shown in Fig. 9. In the southern limb 335 feet of sediments are exposed, in the northern limb 85 feet, and between these two limbs there are no exposures. A fault probably exists between the exposures, as the strata do not match on either side of the gap.

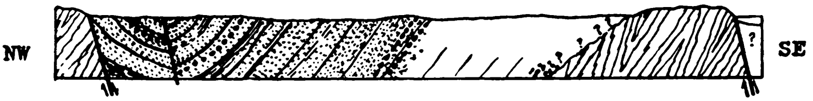

FIG. 9.—Cross-section of the Martin Head Triassic area. Martin Head itself, composed of pre-Cambrian strata, is on the right. Between it and the pre-Cambrian uplands on the northwest are the Triassic sediments. The unconformable contact of the Triassic with the pre-Cambrian on the southeast is hypothetical.

The sediments in the Martin Head area are principally yellow sandstones and shales, with occasional pale-red beds, and transition colors. The yellow is a bright-chrome shade, much brighter than that of the Quaco conglomerate, which is merely that of the common stream gravels. Conglomeratic beds occasionally appear. The sediments are characterized by a notable amount of muscovite and of calcite. The former has evidently been derived from the pre-Cambrian mica schists on the north.

Lignite occurs at several horizons in the yellow beds, as carbonized twigs, limbs, and bits of wood, often 2–3 inches in diameter. This lignite has been described by Miss Ruth Holden,[1] and the paper is summarized below in treating of the age of the Acadian Triassic. As the plant remains appear to be similar to those found at Quaco, the sediments in the two areas may be correlated with each other.

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[1] Ruth Holden, "Fossil Plants from Eastern Canada," *Annals of Botany*, XXVII (1913), 243–55.

Waterside.—On the north side of Chignecto Bay is a strip of Triassic at Waterside, 20 miles northeast of Martin Head. The length of the strip is about 4 miles, extending from Dennis' break-water on the west to the eastern end of the marsh at Little Rocher on the east (Fig. 10), but the length of the actual exposures of Triassic sediments is about 1½ miles.

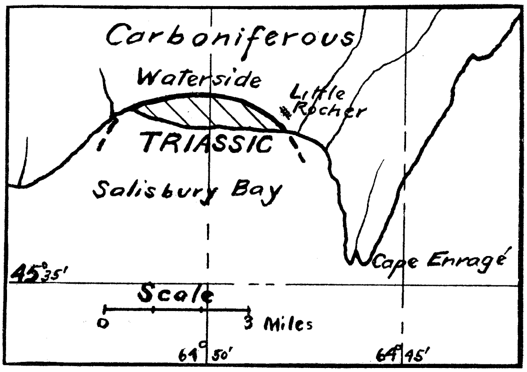

FIG. 10.—Map of the Waterside area of Triassic sediments.

The structure of this area is anticlinal on the west and synclinal on the east, with the axis of the syncline at the Waterside wharf. The dip of the folds is gentle, exposing only 320 feet on the eastern limit of the anticline. On the west, the Triassic is faulted against a sheared Carboniferous conglomerate, but the contact is concealed by a Pleistocene delta deposit. This same fault probably bounds the Triassic area on the north and east, but it is not again exposed.

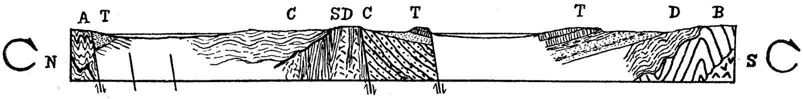

FIG. 11.—Geologic cross-section, CC, from Waterside, on the north, through Cape d'Or, across Minas Channel, and through North Mountain. *A*, pre-Cambrian; *B*, Meguma series (pre-Cambrian); *SD*, Cobequid group (Silurian, cut by Devonian igneous rocks); *D*, Devonian; *C*, Carboniferous; *T*, Triassic. The major fault of the region is shown in the center of the section, where the Carboniferous and Triassic are dropped down against the Cobequid group.

The Waterside Newark strata consist of pale-red sandstones with occasional conglomerates. At the top of the series there are

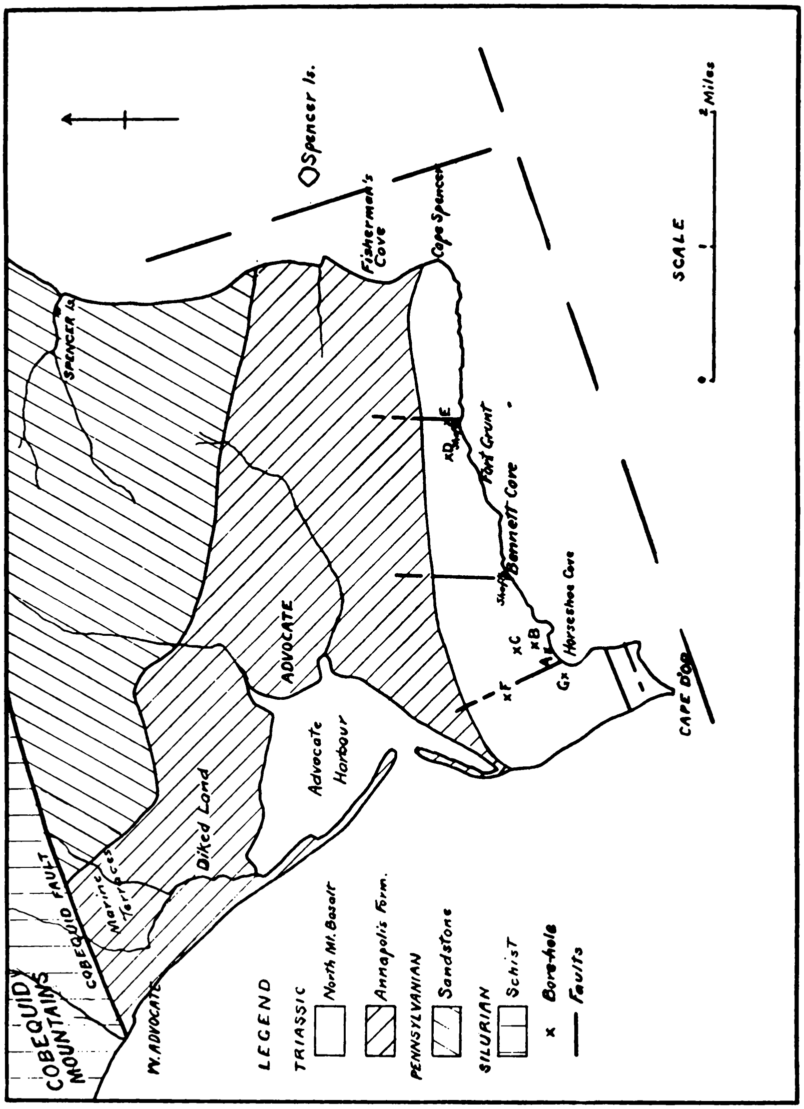

FIG. 12.—Map of the Advocate-Cape d'Or area

several calcitized sandstone beds, which weather out into peculiar forms. Persistent thin green shale or sandstone beds are present.

Contemporaneous erosion channels are seen west of the Waterside wharf.

The Waterside section is to be correlated with the Annapolis formation, but, as no plant remains have been found in it, a more definite correlation is impossible.

Advocate Harbour.—At the southeastern end of Minas Basin is Cape d'Or and north of it is Advocate Harbour. The shore from Cape d'Or to Cape Spencer (Figs. 11, 12) is fronted by basalt cliffs 100 feet or more in height. The lowlands on the north are underlain by Triassic sandstone, and, farther north, by Carboniferous sediments. North of the latter are the Cobequid Mountains, fronted by a fault-line scarp rising abruptly from the lowlands.

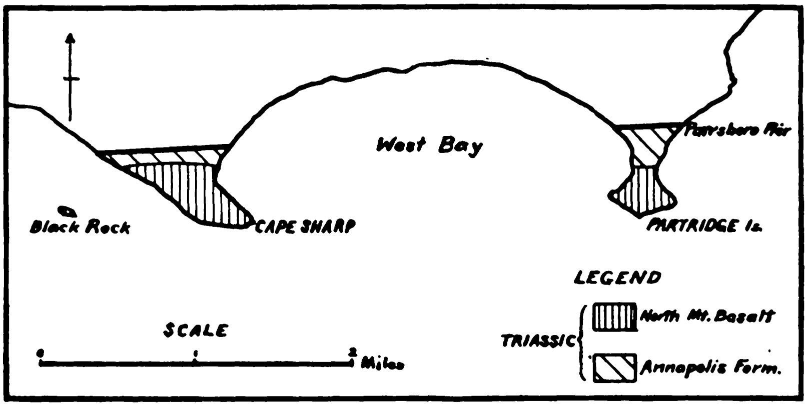

FIG. 13.—Map of the Cape Sharp-Partridge Island region

The upland from Cape d'Or to Cape Spencer, and the islands, Isle Haute and Spencer Island, are composed of basalt flows dipping southward at a low angle. Five flows are exposed at Cape d'Or in drill-cores. The base of the flows rests on Newark shale and sandstone of a white or red color. Both the basal amygdaloid and the underlying sediments are penetrated by gypsum veins.

North of Cape Spencer, very coarse conglomerates, which are probably of Newark age, are exposed. The bowlders in this conglomerate are a foot or two in diameter.

On the shore near West Advocate is the only other exposure of Newark sediments in this area. Red sandstone, with some red shale, and thin greenish or white bands of sandstone, are dipping eastward. Adjoining these sandstones, on the north, is Silurian carbonaceous schist of the Cobequid group, separated by a fault which may be traced down the beach in a S. 71° W. direction. This is the main Cobequid fault, shown in Fig. 10. Other minor faults are shown in the same map.

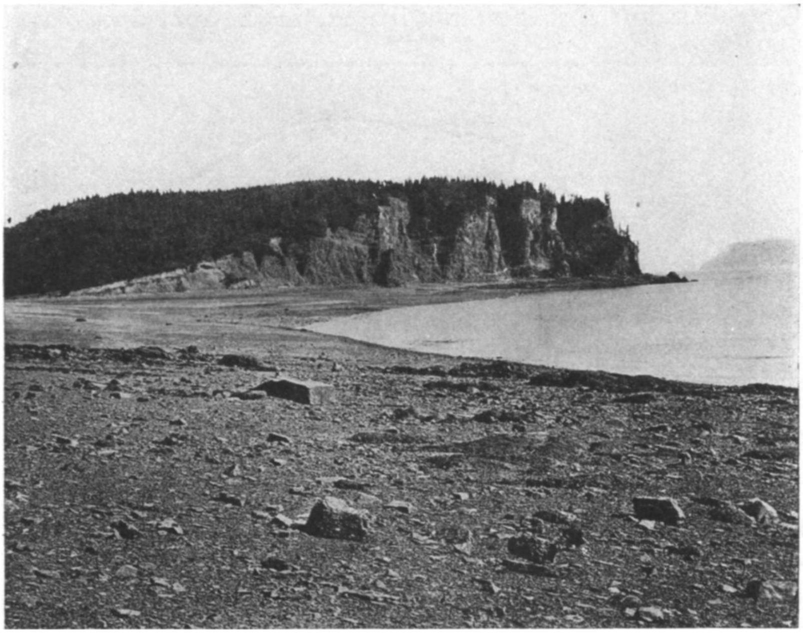

FIG. 14.—Partridge Island from the west, showing basalt flows overlying red sandstones. The sandstones appear along the gentle slope at the left-hand side of the cliff.

Cape Sharp.—To the east of Cape Spencer, Cape Sharp is the first promontory. It consists of basalt, as does Black Rock on the west (Fig. 13). On the north of Cape Sharp is a lowland underlain by red Triassic sandstone and shale with occasional green bands, and north of this is a rolling country underlain by Carboniferous sediments.

The basalt on Cape Sharp consists of one or more flows—probably two flows—which dip to the south at an angle of about

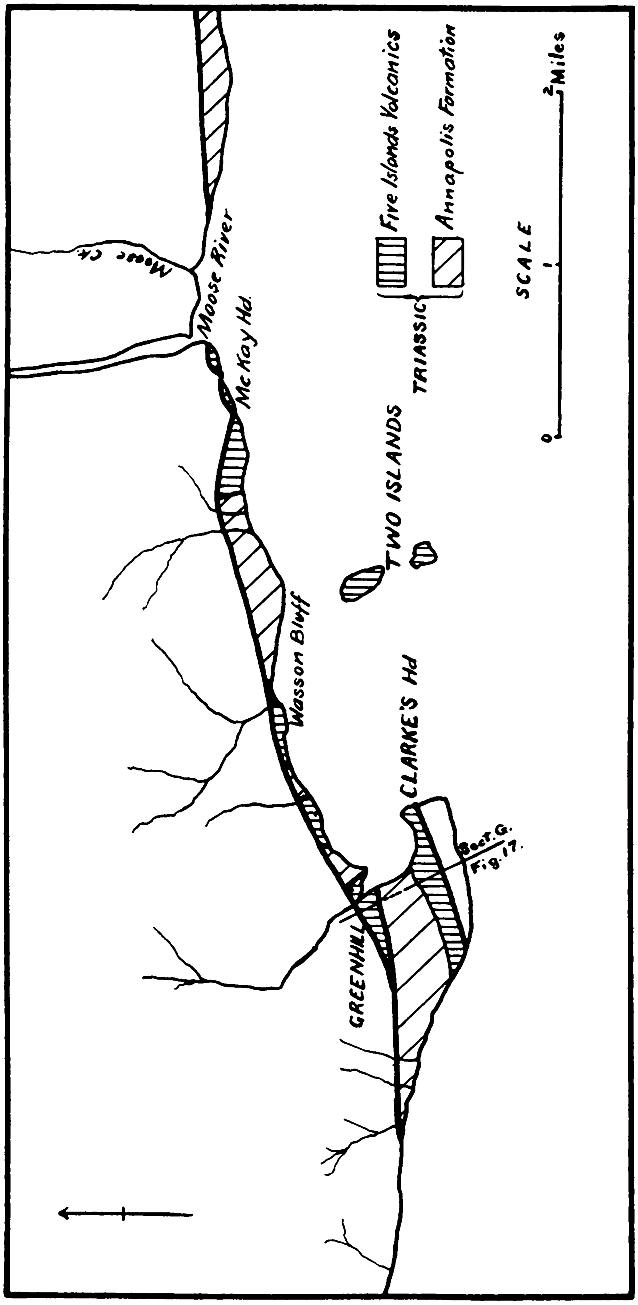

FIG. 15.—Map of the Two Islands region

5°–10°. The shale and sandstone underlying the basalt are exposed on the northeast side, for a short distance only. The sandstone is seen to be in fault contact with the Carboniferous shales and sandstone to the north.

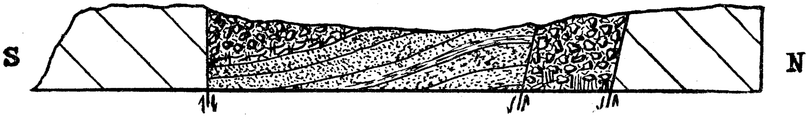

FIG. 16.—Structure section, G, through Clarke's Head, on the south, and Swan Creek, on the north. The structure of the pre-Triassic rocks is not shown. Overlying the Triassic red sandstone is a bed of tuff, overlain, in turn, by agglomerate. At Swan Creek only agglomerate appears, but it is probably a part of the same flow.

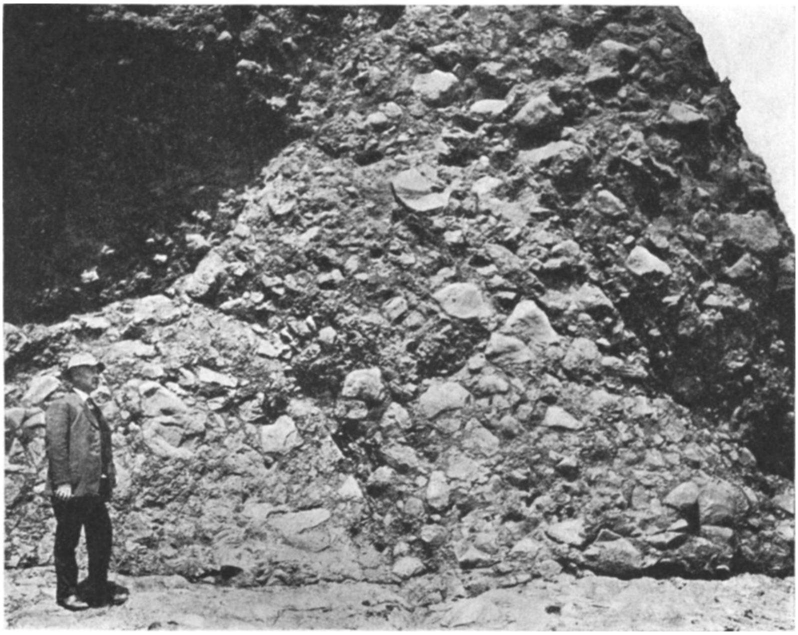

FIG. 17.—A detailed view of the agglomerate which comprises a large portion of the Five Islands volcanics. The photograph shows the center of a 100-foot bed of the agglomerate east of Blue Sack. The angular blocks are composed of basalt, and the matrix is tuffaceous.

Partridge Island.—East of Cape Sharp is a peninsula called Partridge Island, formed of a mass of basalt connected with the shore by a low, swampy area which is covered by the sea at very high tides. On the northwest is Gilbert's Cliff, rising to a height of 60 feet, and on the northeast Parrsboro Pier (Fig. 13).

The basalt on Partridge Island (Fig. 14) is partly columnar and partly vesicular. It probably consists of two flows. Stilbite is very abundant in geodes in the amygdaloid. At the base of the lower flow the highly weathered amygdaloid is 15 feet thick.

The Triassic shales and sandstones are seen underlying the basalt on the west side of the island, dipping southward at an angle of 10 to 35 degrees. Near Gilbert's Cliff are red clays of Recent age, overlying the beveled, upturned edges of the ripple-marked Pennsylvania shales. The Triassic is not exposed to show whether this surface was the one on which the Triassic was deposited or whether it was the one made by the Pleistocene ice-sheet.

Greenhill–Five Islands.—From a point 3 miles east of Parrsboro, near Greenhill, to Five Islands, there is an almost continuous strip of Triassic, faulted down against the Riversdale–Union series of Pennsylvanian age (Fig. 15). The entire region has suffered extensive faulting and, with these movements, gypsum veins have been introduced.

The Newark comprises red sandstones and some shales, with occasional beds of green sandstone or shale; tuff and agglomerate beds; and basalt flows. The distribution of these rocks is very irregular, owing to the faulting, and is disturbed by extensive landslides in the volcanics.

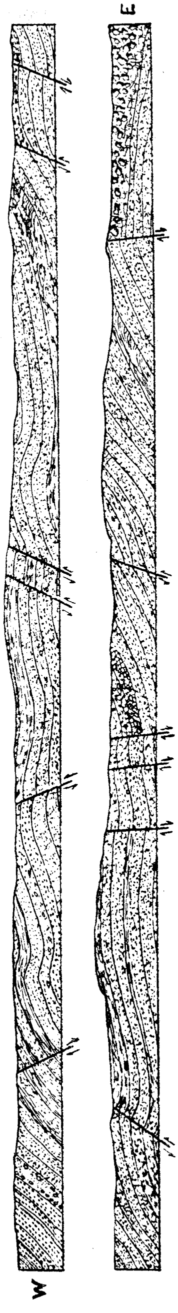

FIG. 18.—Structure section from Moose Creek toward Blue Sack, a distance of about 2 miles, showing the character of the folding and faulting in the sediments as seen in the shore exposures. The height of the cliffs is 150–200 feet. On the extreme right, a bed of agglomerate of the Five Islands volcanics is shown, overlying sandstone.

West of Clarke Head is an excellent exposure showing sandstones overlain by black ash, and this by agglomerate, the whole being cut off by a fault (Fig. 16). North of Clarke Head, agglomerate is exposed, and copper has been sought at this locality.

East of Swan Creek, sandstone appears, overlain by a volcanic conglomerate—a mass of fragments 6 inches to 2 feet in diameter, of various kinds of basalt and agglomerate, imbedded in a red sandstone matrix. Above this, with a gradual transition, comes a true agglomerate of angular blocks imbedded in a tuffaceous matrix (Fig. 17). Sandstone appears above the agglomerate, and the contact is locally cross-cutting.

At Wasson's Bluff, agglomerate appears above red sandstone, with a conformable contact. East of Wasson's Bluff the agglomerate rests unconformably on the sandstone. Another local unconformity is found at McKay Head, where the sediments are overlain by agglomerate with columnar basalt above. East of McKay Head are two remnants of the same basalt, with faulted contacts. The cross-cutting nature of some of the contacts may indicate volcanic vents.

Two Islands, known also as The Brothers, consist of basalt flows dipping gently northwest. The islands are probably separated from each other and from the mainland by faults.

East of Moose River the sediments reappear and extend from this point around Minas Basin, continuously as far as the Shubenacadie River. The structure of the sandstones between Moose River and Five Islands may be seen in Fig. 18. Near Blue Sack (see Fig. 19) they are greatly slickensided, as shown in detail in Fig. 20.

On the top of the cliffs east of Moose River, tuff, overlain by agglomerate, forms a capping for the sandstone. The thickness of the volcanics varies, but is only 100 feet at a maximum. Near Blue Sack are two beds of agglomerate interbedded with sandstone, the lower being 100 feet or more, the upper 20 feet, with 10 feet of intervening sandstone. One of the contacts is cross-cutting, but there can be little doubt that the volcanics were formed contemporaneously with the sandstone, as blocks of basalt occur in the latter.

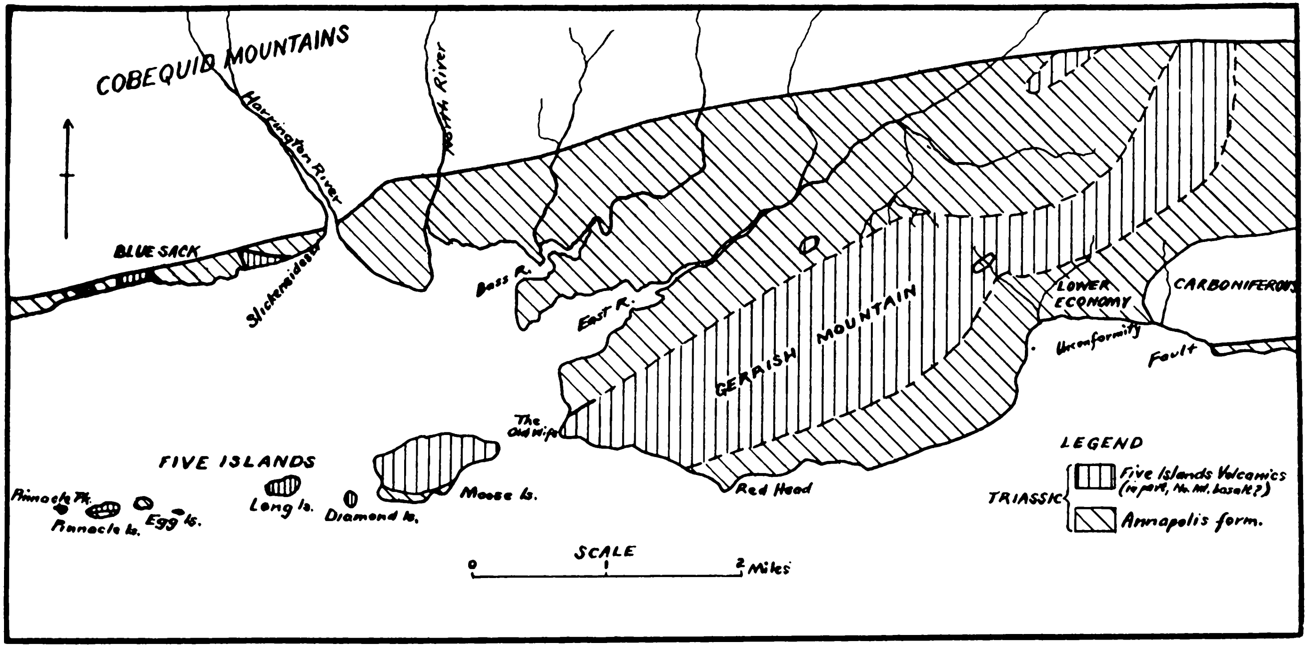

FIG. 19.—Map of the Five Islands region

This strip of Triassic is bounded on the north by a fault which probably continues east almost as far as Truro. The fault may be seen near the town of Two Islands, and between Moose Creek and Blue Sack the older rocks may be seen in one place at the top of the cliffs, in contact with the Triassic volcanics.

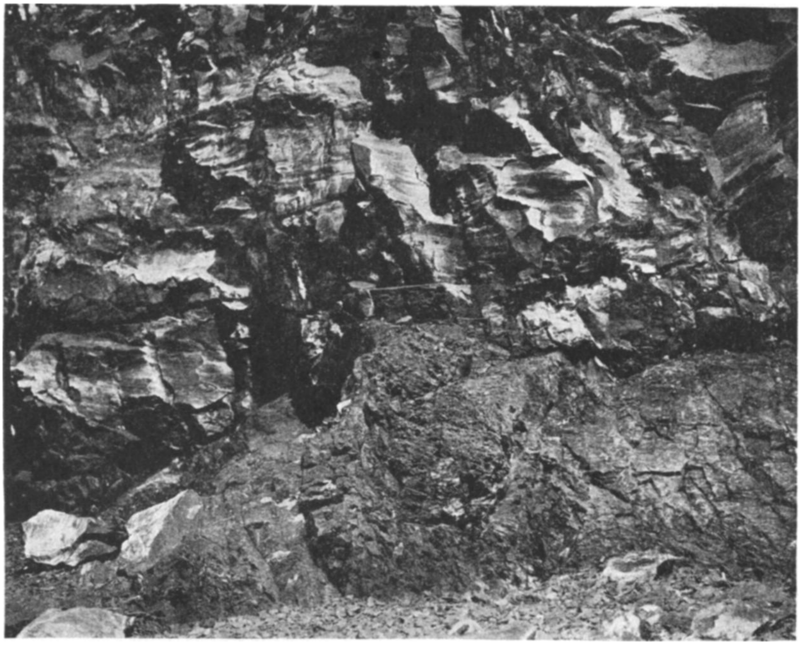

FIG. 20.—A detailed view of the slickensides north of Long Island of the Five Islands. The polished surfaces strike at right angles to the beach and the movement has been horizontal. Little or no vertical displacement is shown, but the slickensided surfaces strike toward the Five Islands between each of which there is a fault. It is impossible to determine which are the major fault-planes.

Five Islands.—The Five Islands are situated west of Gerrish Mountain. Their names, from east to west, are: Moose, Diamond, Long, Egg, and Pinnacle islands, and Pinnacle Peak (Fig. 21). Moose Island is nearly a mile in length and half a mile in width. The highest point on it is 350 feet above sea-level. Diamond Island is a small, round island, Long Island is one-quarter of a mile long and 180 feet in height at the center. Egg Island is smaller and round. Pinnacle Island is a quarter of a mile long and 130 feet in height in the center. Pinnacle Peak is merely an erosion pinnacle. East of Egg Island at ebb tide is Egg Rock. At low tide, with a high run of tides, the sea-bottom between the islands and the mainland is left dry except for numerous deep river channels through the soft red clay.

Moose Island consists of basalt flows on the north, underlain by red sandstones on the south. On the west end there is a fault between red amygdaloid and the sandstone, with a number of gypsum veins near the contact. On the east side the amygdaloid and basalt above dip north at angles of 45° above the sandstone. At the base of the amygdaloid is greenish-white ash, 2 feet thick, similar to that at Gerrish Mountain. Fletcher's mapping of Moose Island and of the other Islands is largely incorrect.

Diamond Island consists of a portion of the same basalt flows as on Moose Island and the other islands. The dip of the basalt is about 40° northeast.

Long Island consists of basalt on the north and sandstone on

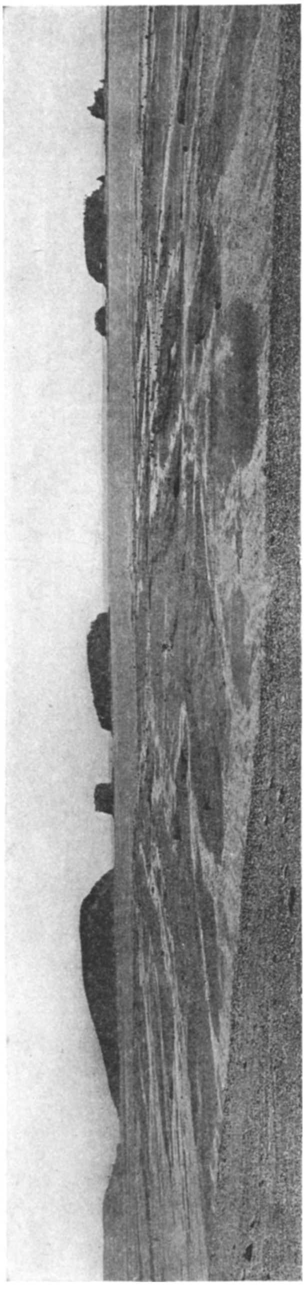

FIG. 21.—The Five Islands. On the left is Gerrish Mountain. The Five Islands are, from left to right: Moose, Diamond, Long, Egg, and Pinnacle islands, and Pinnacle Peak. Complex block-faulting separates these islands.

the south, with the contact striking nearly east and west. The dip of the sandstone and basalt is variable owing to minor folds, but is in general in a northerly direction about 20°.

Egg Island and Egg Rock on the east consist wholly of red sandstone, dipping northwestward about 15°. Pinnacle Island consists of red sandstone on the south and basalt on the north, dipping northwest at angles of 20°–40°. Pinnacle Peak consists of basalt.

Each of the islands is separated from the others by a fault, and they are probably bounded on the north by a continuation of the Gerrish Mountain fault. On each island the flows or sandstones dip northward, but at different angles.

The basalt flows of the Five Islands were undoubtedly originally connected with the flow on Gerrish Mountain and with those on the Two Islands. They do not, however, appear to be directly connected with the agglomerate and tuff which are exposed along the shore. Probably the dike in Gerrish Mountain was the source of most of the igneous material, part of which flowed out, and part of which was blown out. The relative age of the pyroclastic material and the flows could not be determined.

[*To be continued*]